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ABSTRACT:

The invention concerns a method for the management of certificates stored on an identity module. In the method, a certificate is received to the identity module, and information obtained from said certificate is stored on the identity module. The invention makes it possible to increase the number of certificates that can be stored on the identity module.

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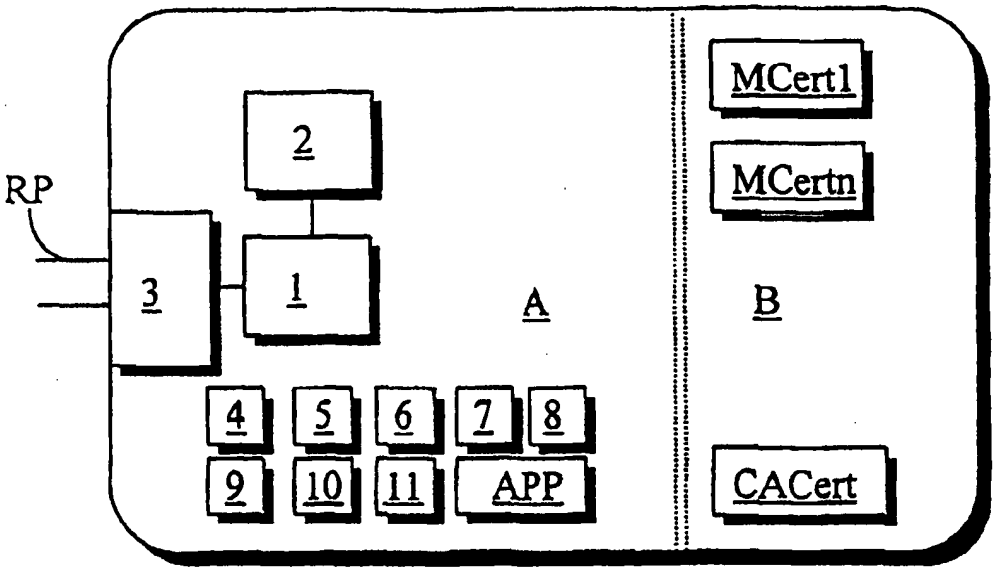

(57) Abstract

The invention concerns a method for the management of certificates stored on an identity module. In the method, a certificate is received to the identity module, and information obtained from said certificate is stored on the identity module. The invention makes it possible to increase the number of certificates that can be stored on the identity module.

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MANAGEMENT OF AN IDENTITY MODULE

FIELD OF THE INVENTION

The present invention relates to telecommunication systems and devices. In particular, the invention relates to a method for the management of an identity module and to an identity module which comprises means for the management of its storage areas.

The invention concerns a method for the management of certificates stored in an identity module. In the method, a certificate is received into the identity module, and information obtained from said certificate is stored on the identity module.

BACKGROUND OF THE INVENTION

Mobile communication networks, e.g. GSM networks (GSM, Global System for Mobile communications) have become very popular in recent times. Supplementary services associated with mobile communication networks are correspondingly increasing at an ever faster pace, in widely varying fields of application. The mobile telephone can be used, among other things, as a means of paying for small purchases e.g. in automatic vending machines for refreshment drinks and in automatic car wash systems. Everyday functions, such as payment functions, have been and will be added to the services available via mobile stations. Next-generation mobile stations will be considerably more advanced than their predecessors in respect of service level and data transmission capacity.

At present, a known practice is to use a digital GSM mobile station or other electronic and wireless terminal device having a unique identity for commercial transactions, such as paying a bill or remitting a payment by an electronic method. Patent specification US 5,221,838 presents a device which can

be used for remitting a payment. The specification describes an electronic payment system in which a terminal device capable of wireless and/or wired data transfer is used as a payment terminal. The terminal device according to the specification comprises a card reader, a keypad and a bar code reader for data input and a display for visual presentation of payment information.

Patent specification WO 94/11849 presents a method for the utilization of telecommunication services and execution of payment transactions via a mobile communication system. The specification describes a system comprising a terminal device which communicates over a telecommunication network with a service provider's mainframe computer containing the service provider's payment system. The terminal device, i.e. mobile station used in the mobile communication network, can be provided with a subscriber identification unit which contains subscriber data for subscriber identification and encryption of telecommunication. The data can be read into the terminal device for use in mobile stations. As an example the specification mentions the GSM system, in which a subscriber identity module (SIM) or a SIM card is used as a subscriber identification unit.

In a system described in specification WO 94/11849, a mobile station communicates with a base station in a mobile telephone network. According to the specification, a connection is further established from the base station to a payment system and the amount to be paid as well as the data needed for subscriber identification are transmitted to the payment system. In a bank service as described in the specification, the client inserts a bank service card containing a SIM unit into a terminal device of a GSM network. In the telephone based bank service, the terminal device may be a standard GSM mobile station. By

the method described in the specification, a wireless telecommunication link can be used for implementing bank or cash services, such as remittance of payments and/or payment of bills or the like. It would also be possible to use some other terminal device as a payment terminal. An important point is that the terminal device contains or can be provided with an identity module having its own unique identity. It may also be a separate fail-safe circuit or equivalent.

A digital signature, which is considered a general requirement in electronic payment systems, is used for the verification of the integrity of the material transmitted and the origin of the sender. A digital signature is generated by encrypting a hash code computed from the material to be transmitted, using the senders secret key. As nobody else knows the sender's secret key, the receiver decrypting the material by using the sender's public key is able to ascertain that the material is unchanged and that it has been generated by the sender using his secret key known to himself. An example of an algorithm used for generating a digital signature is the RSA encryption algorithm, which is a public-and-secret-key encryption system and which is also used for the encryption of messages.

To make it possible to use uniform procedures for reliable identification of the parties to a transaction or other agreement via a telecommunication network, it is necessary to have an electronic identity and means for proving and ascertaining the identity. An electronic identity like this may also be e.g. a so-called network identity (Net-ID). An electronic identity is based on personal data stored on a smart card, subscriber identity module, electronic fail-safe circuit or equivalent and the use of a key pair, a secret key and a public key, stored in a certificates directory maintained by a trusted third party. Using

such a technique, it is possible to implement, among other things, the identification of parties, electronic signature, encryption and indisputability of transactions, in a manner providing a security level sufficient for the authorities and other service providers.

In the present application, 'identity' refers to individualizing information which is attached to a person or a juridical person holding an identity and which can be used to identify the person or holder. Likewise, 'identity' may refer to individualizing information pertaining to an application or service and allowing the application or service to be identified.

In a public key method, the user keeps a secret key in private use only while a public key is publicly available. Storing the public key as such in a public directory, e.g. in a x.500 or LDAP directory, is not enough because someone might forge it and then act in the name of the rightful owner of the key. Instead, it is necessary to have a certification service and a certificate, which means an evidence given by a trusted third party (certifier) vouching that the name, the personal identifier and the public key belong to the same person. The certificate is generally a data aggregate consisting of the person's public key, name, personal identification number and other information, and it is signed by the certifier using his own secret key.

When the receiver of a message provided with an electronic signature wants to ascertain whether the message is an authentic one, he must first get the sender's certificate, from which he will learn the sender's public key and name. After this, he must verify the authenticity of the certificate. To this end, he may have to obtain additional certificates (certification chain) which have been used to certify the certificate in question.

If the certificate is authentic, the receiver verifies the signature of the message by using the public key received in the sender's certificate. If the signature passes this test, then the sender is the person indicated by the certificate. The use of certificates also necessitates the use of a freeze file in which discarded certificates are listed. For the certificates and the freeze file, directory services are needed.

When different applications used for electronic payment, commercial transactions, banking etc. are stored on the identity module, the public keys used in the services provided by service providers, such as stores, banks and other organizations providing electronic services, used by these applications are stored at the same time. Public keys can also be stored later depending on the services used by the user of the subscriber identity module. Thus, the user of the identity module need not obtain a certificate for each transaction separately as the certificate is already on the identity module.

The longer the certification chain created to produce a certificate, the more information is needed for the verification of the certificate. Certificates requiring a large amount of memory are a problem to current identity modules because the identity module often has a limited memory space. This is a significant factor limiting the use of the identity module for different services having different certificates. Therefore, it is an urgent objective to reduce the size of the certificate to allow a larger number of certificates to be stored on a single identity module. A given service application may use several certificates when communicating on the user's behalf with the services of different service providers. Thus, the number of different services usable via the identity

module is almost exclusively limited by the size of the certificates.

OBJECT OF THE INVENTION

The object of the present invention is to eliminate the problems referred to above or at least to significantly alleviate them. A specific object of the invention is to disclose a method and an identity module that will make it possible to define the size of a certificate or at least to reduce it, thus allowing the number of certificates stored on a single identity module for use in a mobile communication environment to be increased.

A further object of the invention is to disclose a method whereby a larger number of certificates than before can be stored on the identity module without breaking the reliability chain in a chain of certificates.

As for the features characteristic of the invention, reference is made to the appended claims.

BRIEF DESCRIPTION OF THE INVENTION

The main principle of operation of the solution of the invention is to store the required certificates on the identity module so that the certificates comprised in a certification chain are removed from them. The identity module may be a SIM (Subscriber Identity Module), a WIM (Wireless Identity Module), a security module or a corresponding separate fail-safe circuit or a similar device or component used to manifest identity. The identity module may be a fixed or a detachable component and it must be manageable by the owner of the identity. A certificate received on the identity module may be saved if it can be authenticated using a card certificate stored on the identity module. After the certification chain has

been removed, the remaining public key and the associated identity are stored in a protected storage area to which no access is allowed for any other applications than the application used by the card certificate. Every time when a service application in the identity module wants to use a certificate stored on the card, it requests it from the application used by the card certificate from the protected storage area. The application used by the card certificate verifies the certificate read from the protected storage area and when the user trusts the issuer of the card certificate, the user can also trust the certificate read from the card.

The basic idea of the invention can be expressed in a nutshell as follows. A functional unit has been divided into two sections A and B and a condition C. The functional unit may be the storage device or memory of the identity module and the condition C may be a filter or algorithm controlling the storage space. The function of section A is a known, open memory area and its functionalities can be influenced by known instructions, the operating system of the identity module. Section B may function in the same way as A, but the functionalities of B may only be used by a party who knows the conditions C. In the present case, the condition C is only known to the certification authority D issuing the card certificate and to the filter or algorithm on the card which controls the protected storage area.

When a new certificate is to be stored on the identity module, the deliverer of the new certificate asks a certification authority D to store the certificate on the identity module. Certification authority D authenticates the new certificate received from another certification authority E and selects from the certificate only those components F which necessarily have to be stored on the identity module.

Certification authority D generates his own certificate G from the new certificate given by E and from the selected components F. Appropriate information about certificate G needed to make it possible to read from which certificate the material F has been generated and to establish that the material has been certified by certification authority D is filed in the directory.

Since only certification authority D knows the conditions regarding the manner in which F is to be disposed in the protected area B, F can be regarded as a certificate that is not public and that can be trusted.

In the method of the invention for the management of certificates stored on the identity module, the certificate is received to the identity module and information about said certificate is stored on said identity module. The identity module comprises a storage device of a data processing apparatus, said storage device being connected to said data processing apparatus, a card certificate stored on the storage device, an application which uses the certificates stored on the identity module, and a data transfer device connected to said data processing apparatus and provided with a communication interface for the transfer of data between an external device, such as a mobile station, and the identity module.

According to the invention, the authenticity of said certificate is verified by means of said card certificate before the certificate is stored, and the certification chain contained in said authenticated certificate is filtered out from it. Before the filtering, each signature and certificate comprised in the certification chain can be additionally verified separately if necessary. After the filtering, the portion of the certificate remaining to be stored comprises the public key contained in it and the identity

associated with it, but other information may be stored as well. In this way, the amount of storage space occupied by the certificate can be significantly reduced. When the certificate is to be used, it must first be verified by means of the card certificate.

In an embodiment of the invention, the certificate is rejected if a verification carried out before its storage or use indicates that the certificate is unreliable. In addition, when reliable means and software are used, the certificates and the transactions implemented using them can be trusted. However, we wish to point out here that, if the card certificate is rejected, this does not necessarily mean that the certificate could not be used by an application on the card. Thus, if any one of the applications identifies the certificate, then it can be stored on the identity module. The only difference to the filtered certificate is that the certificate is stored in its complete form without filtering out anything from it.

The identity module of the invention for the management of certificates comprises the above-mentioned components. Moreover, the identity module comprises means for receiving a certificate to the identity module and means for saving information contained in said certificate to a storage device.

According to the invention, the identity module comprises means for verifying the authenticity of the certificate by means of said card certificate before the storage of the certificate and means for filtering out a certification chain contained in the authenticated certificate from the certificate. Furthermore, the identity module comprises means for verifying the certificate by means of the card certificate before its use.

In an embodiment of the invention, the identity module further comprises means for rejecting the certificate if a verification carried out before its

storage indicates that it is unreliable, and means for rejecting the certificate if a verification carried out before its use indicates that it is unreliable. Moreover, the identity module may comprise means for verifying the authenticity of each signature contained in said certificate before the filtering.

As compared with prior art, the present invention has the advantage that a larger number of certificates than before can be accommodated in a limited storage space. In particular, the invention allows a larger number of certificates to be stored on the identity module or on a smart card.

A further advantage of the invention as compared with prior art is that an update of the identity module with new certificates and applications can be certified by the certification method of the invention using a card certificate.

LIST OF ILLUSTRATIONS

In the following, the invention will be described by the aid of a few examples of its embodiments with reference to the attached drawing, wherein:

Fig. 1 is a diagrammatic representation of an identity module according to the present invention,

Fig. 2 is a diagrammatic representation of a method according to the present invention for storing a certificate on an identity module, and

Fig. 3 is a diagrammatic representation of a message structure which can be used in the method of the present invention.

Although the invention is described in the following examples by referring to a subscriber identity module, it can be applied in conjunction with any terminal device that uses identity modules as mentioned above. The invention is not limited to GSM network subscriber identity modules.

The subscriber identity module (SIM) presented in Fig. 1 comprises a data processing device 1, such as processor, microcontroller or equivalent, a storage device 2 connected to the data processing device 1 and a data transfer device 3 connected to the data processing device 1. Moreover, the subscriber identity module SIM is provided with a communication interface IF for data transfer between an external device, such as a GSM mobile station, and the subscriber identity module.

In addition, the subscriber identity module presented in Fig. 1 comprises an application APP or contains an application APP stored on it, which application uses certificates stored on the subscriber identity module when communicating with services provided by a service provider. Furthermore, the subscriber identity module is provided with means 4 for receiving certificates and means 5 for saving information obtained from the certificate to the storage device 2. Moreover, the subscriber identity module comprises means 6 for establishing the authenticity of a received certificate by using a card certificate (CACert) as mentioned above and means 7 for filtering out from an authenticated certificate a certification chain contained in it before the storage of the certificate.

Further, the subscriber identity module presented in Fig. 1 comprises means 8 for authenticating a certificate Mcert_1 stored on the subscriber identity module by means of a card certificate CA_Cert before its use. In addition, the subscriber identity module comprises means 9 for rejecting a certificate if a verification carried out before storage indicates that the certificate is unreliable, and means 10 for rejecting a certificate if a verification carried out before use indicates that the certificate is unreliable. Furthermore, the subscriber identity module com-

prises means 11 for authenticating the signature contained in each of said certificates before the filtering out of the signature.

In addition, referring to the above example, Fig. 1 shows areas A and B, which, as mentioned above, are a non-protected storage area A and a protected storage area B. In the protected storage area is stored at least the card certificate Card_CA, which comprises the card certificate issuer's electronic or network identity, a short name description of the certification authority, certificate type, e.g. RSA, a public encryption key, a public signing key, certificate status, i.e. data indicating whether the certificate is active or passive, and the number of the short message service center, said number referring to the issuer of the certificate. Stored in the protected storage area is also the user's own certificate, which, by way of example, may comprise the same data items as described above in conjunction with the card certificate except that the public encryption key and public signing key are replaced with a secret encryption key and a secret signing key, respectively. The user's certificate is referred to in this example by the term MCert_1. In addition, service providers' certificates, from which the certifying signatures have been removed to reduce the storage space occupied by them, may be stored in the protected storage area B. These certificates are referred to by the designation MCert_n. These certificates, too, preferably contain the same data items as the card certificate.

Next, referring to Fig. 2, a preferred procedure used for receiving a certificate to the subscriber identity module will be described. First, the certificate is received to the subscriber identity module, block 20. The certificate has been authenticated by the issuer of the card certificate, and this is verified in block 21. If it is found that the

authenticity of the received certificate cannot be established even with the card certificate Card_CA stored on a card, then the certificate is rejected. The procedure could alternatively be terminated at this point, but in this example we can assume that retransmission of the certificate is requested, block 25, whereupon the certificate is verified again. This may be repeated e.g. three times, and if even the third attempt fails to prove the certificate to be authentic, then the procedure is terminated.

If it was established in block 21 that the certificate is authentic, then the entire certification chain is filtered out from the certificate, leaving only the public key and the associated identity and possibly some additional data, block 23. After this, the filtered certificate is saved, block 24, to the protected filtered storage area B in the subscriber identity module.

Next, referring to Fig. 3, a few preferred message structures will be described which can be used for the transmission of certificates according to the invention via an air interface to the subscriber identity module. In this example it is assumed that the message type used is short message (Short Message Service, SMS), but, as is obvious to the skilled person, other message types could be used as well. In this example, the certificate is transmitted using three short messages containing information as presented in Fig. 3.

The first message to be sent is a non-encrypted SMS message #1 comprising two fields. PublicKeyMod is a public verification or encryption key. In addition, the message contains the sequence number of the message, MsgNumber. The total length of this message is 1033 bits, of which the public key takes up 1025 bits and the message number 8 bits. The second message, Downloaded Data in message #2, comprises five

fields. S3HDT describes the message type, ReceiverID the identity of the receiver, SenderID the identity of the sender, where the identity may be e.g. a network identity code, S3AP is a pointer referring to an application which uses the certificate in question, and in addition the message comprises an RSA block, ENCDATA, which by default consists of signed and encrypted data. The size of this message is 1120 bits.

The signed and encrypted data, ENCDATA, in the message comprises five fields, the first one of which contains the most significant bit RSA_MSB of the RSA, a start field Start, the root Random of a random number, transmitted data SP_data and a hash code Hash generated from the contents of the SP_data field. The hash code is used to verify the integrity of the information and to ensure that the information has not changed during the transmission.

Further, SP_data in message #2 comprises eight fields, of which the first one, NID, refers to the identity of the card certificate, ShortName refers to the name of the key holder, KeyUsage to the intended use of the key, KeyHash to a hash code generated from message number 1, MCertHash to a hash code generated from the certificate, and a message number, MSG Number. Finally, a third message is sent, which further is part of the SP_data field of message 2 ENCDATA, this field further containing a pointer to the key pair NID of the issuer of the card certificate, the exponent PublicKeyE of the public key and the sequence number MsgNumber of the message. We wish to point out further that the above description of message structures is not to be taken as a limitation but rather as an example of the application of the invention. In the verification of the authenticity of a certificate received to the subscriber identity module, the above-described hash codes are used. By means of these, it is possible to make sure that the re-

ceived certificate has been signed and authenticated by a given predetermined certification authority or certificate issuer. After it has been established that the certificate is authentic, the public key and the associated identity can be picked out or filtered from it and stored in the filtered area B.

The invention is not restricted to the examples of its embodiments described above; instead, many variations are possible within the sphere of protection defined in the claims.

CLAIMS

1. Method for the management of certificates stored on an identity module, said identity module comprising:

- a data processing device (1),
- a storage device (2) connected to said data processing device (1)
- a card certificate (CA) stored on the storage device,
- an application (APP) which uses the certificates stored on the identity module, and
- a data transfer device (3), which is connected to said data processing device (1) and which is provided with a communication interface (IF) for the transfer of information between an external device and the identity module, said method comprising the steps of:
- receiving a certificate to the identity module, and
- storing information obtained from said certificate on said storage device, characterized in that the method further comprises the step of:
- authenticating said certificate by means of said card certificate before storage of the certificate.

2. Method according to claim 1, characterized in that said authenticated certificate is filtered to remove from it a certification chain contained in it.

3. Method according to claim 1 or 2, characterized in that said certificate is authenticated by means of the card certificate before its use.

4. Method according to claim 1, characterized in that, of the information contained in said certificate, the public key and the associated identity are stored.

5. Method according to claim 1, characterized in that said certificate is rejected if a

verification carried out before its storage indicates that it is unreliable.

6. Method according to claim 1, characterized in that said certificate is rejected if a verification carried out before its use indicates that it is unreliable.

7. Method according to claim 1, characterized in that during the filtering:

each signature comprised in said certificate is verified,

and only signatures that the verification proves to be authentic are filtered out from said certificate.

8. Identity module for the management of certificates, said identity module comprising:

- a data processing device (1),
- a storage device (2) connected to said data processing device (1)
- a card certificate (CA) stored on the storage device,
- an application (APP) which uses certificates,
- a data transfer device (3), which is connected to said data processing device (1) and which is provided with a communication interface (IF) for the transfer of information between an external device and the identity module, said system comprising:
- means (4) for receiving a certificate to the identity module, and
- means (5) for storing information contained in said certificate on said storage device, characterized in that the subscriber identity module further comprises:
- means (6) authenticating said certificate by means of said card certificate before storage of the certificate.

9. Identity module according to claim 8, characterized in that the identity module further comprises

means (8) for filtering out from the certificate a certification chain contained in said authenticated certificate.

10. Identity module according to claim 8, characterized in that the identity module further comprises means (8) for establishing the authenticity of said certificate by means of a card certificate before its use.

11. Identity module according to claim 8, characterized in that the identity module further comprises means (9) for rejecting said certificate if a verification carried out before its storage indicates that it its unreliable.

12. Identity module according to claim 8, characterized in that the identity module further comprises means (10) for rejecting said certificate if a verification carried out before its use indicates that it its unreliable.

13. Identity module according to claim 8, characterized in that the identity module further comprises means (11) for verifying the authenticity of each signature contained in said certificate before the filtering.

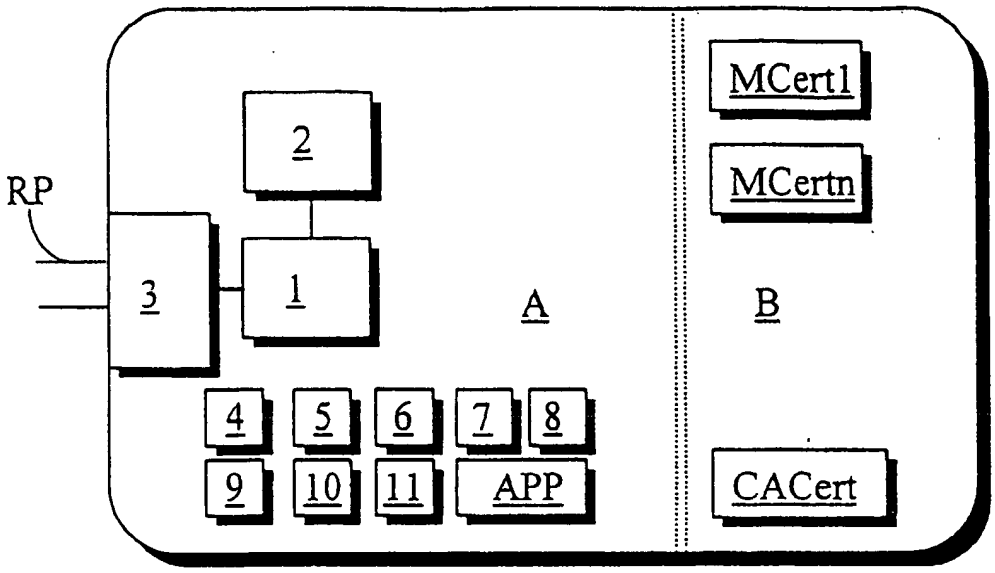

MCert1
MCertn
2
RP
3
1
A
B
4
5
6
7
8
9
10
11
APP
CACert

Fig. 1

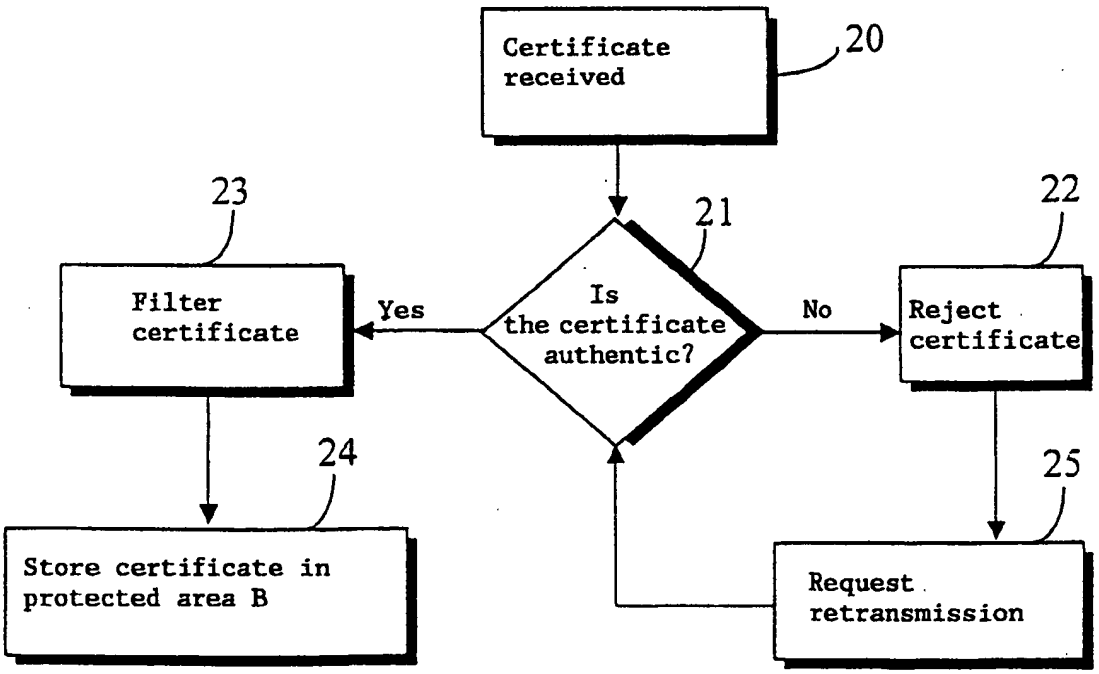
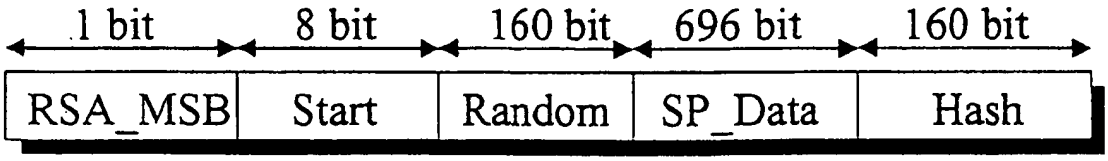
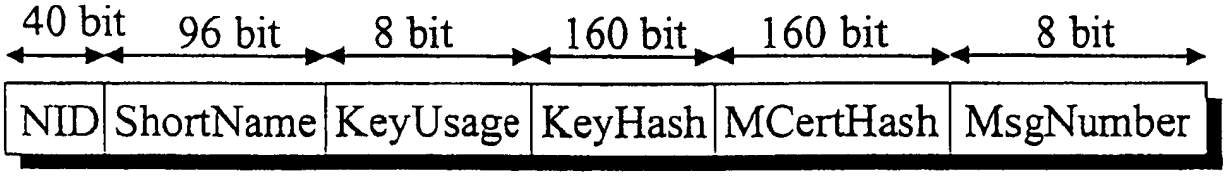

Certificate received
20
23
21
22
Filter certificate
Yes
Is the certificate authentic?
No
Reject certificate
24
25
Store certificate in protected area B
Request retransmission

Fig. 2

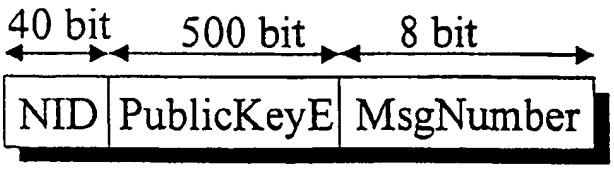
EncData in message#2 (1025 bit)



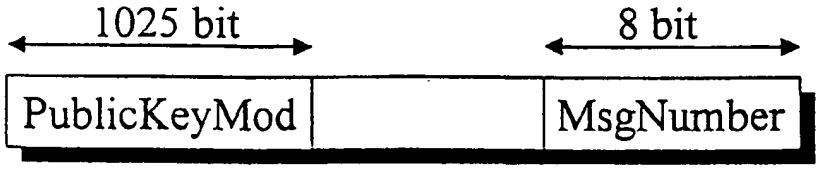
SP_Data in message#2 (696 bit)



SP_Data in message#3 (548 bit)



Non encrypted SMS-message#1



Downloaded Data in message#2

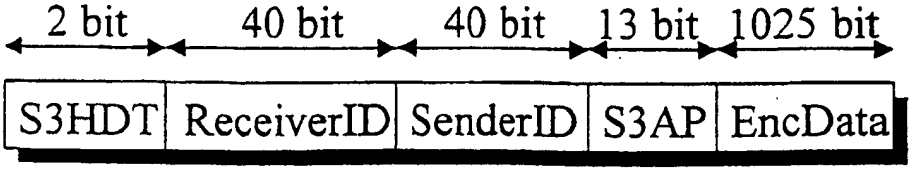


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 00/00328

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04Q 7/32, H04M 1/66, H04L 9/32, G07F 7/08
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04Q, H04M, H04L, G07F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5878144 A (DAVID W. AUCSMITH ET AL), 2 March 1999 (02.03.99), column 1, line 65 - column 2, line 26	1-13
A	EP 0869637 A2 (ARCANVS KAYSVILLE), 7 October 1998 (07.10.98), abstract	1-13
A	WO 9411849 A1 (VATANEN, HARRI, TAPANI), 26 May 1994 (26.05.94), page 3, line 10 - page 5, line 9	1-13
A	US 5835595 A (ALEXANDER GIBSON FRASER ET AL), 10 November 1998 (10.11.98), abstract	1-13

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 Sept 2000	04 -10- 2000
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Stefan Hansson/MP Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/08/00

International application No.
PCT/FI 00/00328

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		JP 10207755 A	07/08/98